How the earth got its core: A new hypothesis

In the beginning, scientists believe there was an interstellar gas cloud of all the elements comprising the earth. A billion or so years later, the earth was a globe of concentric spheres with a solid iron inner core, a liquid iron outer core and a liquid silicate mantle. No one has given a really satisfactory explanation of how the one evolved into the other.

The current theory is that the primeval cloud's materials accreted to form an initially homogeneous body, and that sometime after accretion the iron, melted by radioactive heating, sank toward the center of the globe. This model has some shortcomings, however. For example, it doesn't explain the observed differences in the chemical composition of the earth, moon and various meteorites.

Now another concept is gaining ground: that the earth may have accreted inhomogeneously, with core formation and accretion occurring simultaneously. In the June 16 NATURE, Don L. Anderson and Thomas C. Hanks of the California Institute of Technology show how.

The sequence in which elements would condense from a cooling cloud is well known. The first thing to accrete, say Anderson and Hanks, would be a radioactive nucleus rich in calcium, aluminum, titanium, thorium, uranium and rare earth elements. They believe that the moon and a type of calcium-rich achondritic meteorite can be considered as prototypes of this nucleus. In size, the earth's nucleus would have been at least as large as the moon.

After formation of the radioactive nucleus, the two continue, iron began to condense and accrete. "The planet Mercury presumably accreted to this stage." Then came the principal mantle materials, such as magnesium silicates. The entire accretion process, they estimate, would have taken only about 50,000 years.

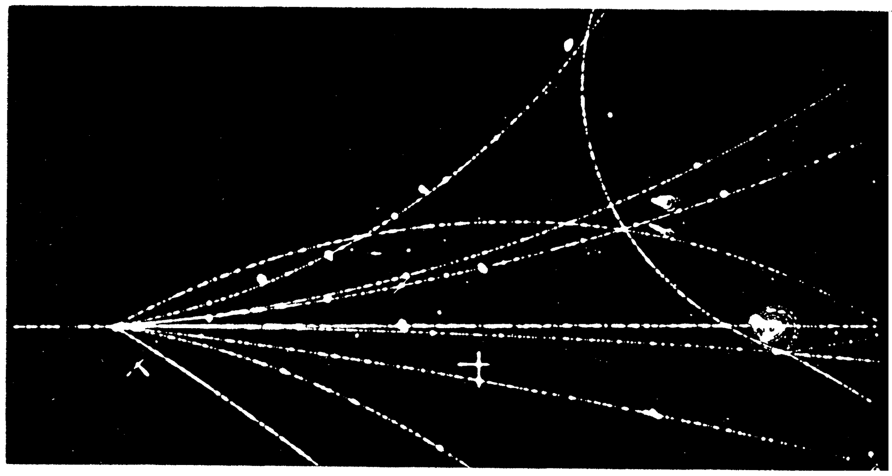
Meanwhile, the heat generated by the radioactive nucleus would have melted the iron. Gravitational equilibrium requires that the densest elements be at the center of the globe, and because iron is denser it would sink to the core. Before its descent, the molten iron would be close to its melting point. Because the melting point of iron rises with an increase in pressure and pressure increases with depth in the earth, the iron would resolidify.

The nucleus, either in fragments or as a whole, would rise to the top of the molten iron zone and eventually to the base of the mantle. Seismic evidence indicates that the inner and outer cores are not of the same composition. Some low density material alloys the iron of the outer core. Anderson and Hanks suggest that part of this extra material in the outer core is residue of the original nucleus.

Furthermore, they estimate that the remnants of the radioactive nucleus would have been less dense than the rest of the mantle materials and some of them might ultimately have melted their way to the earth's surface to initiate continental growth about 3.8 billion years ago. Residual nuclear material, mixed with iron, may account for the properties of the lower mantle transition region, as well. The transition region would vary in thickness or even be absent in some places. "This would lead to a topography at the core-mantle boundary, a feature that is desired to explain certain features of the earth's gravity and magnetic fields."

Finally, Anderson and Hanks suggest that patches of silicate material rich in calcium, aluminum and uranium at the base of the mantle may also be the source of convection plumes in the deep mantle and of the hot spots observed at various locations on the globe.

Anderson and Hanks were not the first to propose inhomogeneous accretion, but their work shows how it can account for the present state of the earth's interior. The formation of the core is a difficult subject for study, and no theory is easy to verify. But Anderson and Hanks point out that their model explains many features of the earth and lacks some of the weaknesses of previous models. □



NAL

First bubble-chamber pictures at 200 GeV

Among the world's first evidence of what happens when a proton with an energy of 200 billion electron-volts strikes a stationary proton is this picture, which records the tracks of ten fragments coming out of the collision. It was taken June 12 at the National Accelerator Laboratory in Batavia, Ill., and released last week. The experiment is aimed at discovering whether the things that happen at these high energies accord with theoretical predictions made from observations at lower energies. Thousands of pictures will be analyzed to find out.

Biological control program

The National Science Foundation has announced a $2 million program aimed at finding biological controls for insect pests on six major crops. Some 250 scientists at several institutions will participate. NSF, the Environmental Protection Agency and the Department of Agriculture are contributing funds.

The crops are alfalfa, citrus, pines, pome and stone fruits (such as apples and peaches) and soybeans. Methods of insect control to be studied include biochemical thwarting of reproduction, introduction of natural enemies and development of insect-resistant plants. The program is part of the U.S. contribution to the International Biological Program. □

Experimental buoy

The large experimental buoy EB-10, which quit transmitting shortly after being anchored in the Gulf of Mexico on June 16 (SN: 6/24/72, p. 407), is now back in operation. Technicians aboard the Coast Guard cutter Acushnet were able to reach the buoy June 23 and make alterations in its computer software. This week, the buoy's measurements of air temperature, dew point and barometric pressure at its site 225 miles out into the Gulf were being relayed regularly to the National Weather Service in Suitland, Md.

The buoy was not yet operating in a totally satisfactory manner, however. Some problems with the computer programming remained, and project officials were using simulations to try to determine how to correct the difficulties.